DOCUMENT RESUME

ED 134 982 CS 003 276

AUTHOR Bulcock, Jeffrey W.; Beebe, Mona J.
TITLE Reading in the Structure of Scholastic Performance.
INSTITUTION Stockholm Univ. (Sweden). Inst. for the Study of International Problems in Education.
PUB DATE Nov 76
NOTE 66p.; Not available in hard copy due to marginal legibility of original document

EDRS PRICE MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS *Academic Achievement; Literature; *Performance Factors; *Reading Comprehension; *Reading Research; Sciences; Secondary Education; Sex Differences; Socioeconomic Influences; Teacher Influence
IDENTIFIERS England; IEA; International Assn Evaluation Educ Achievement

ABSTRACT

The postulate that reading is primarily an indicator of the general level of the individual's thinking and reasoning processes, rather than merely a set of distinct and specialized skills, is examined within the framework of a social psychological model of the structure of scholastic performance. Using data from the English subsample of the IEA survey of achievement in reading, literature, and science, it is shown that reading comprehension accounts for the differences in the subject-matter performances of 14 year olds, to a much greater degree than any other known factor. Socioeconomic circumstances of the children did not directly affect subject-matter performance; rather, background factors were mediated by verbal ability and reading comprehension. Girls outperformed boys in literature and boys outperformed girls in science, but the net disadvantage of the girls in science was less than that of the boys in literature. "Fixed" inputs of scholastic performances were less powerful than were controllable determinants such as reading comprehension; therefore, teachers may legitimately be expected to assume greater responsibility for scholastic performances than heretofore. (Author/AA)

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NOVEMBER 1976

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READING IN THE STRUCTURE OF SCHOLASTIC PERFORMANCE[1]

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ABSTRACT

The Thorndikes' postulate that reading is primarily an indicator of the general level of the individual's thinking and reasoning processes, rather than merely a set of distinct and specialized skills, is examined within the framework of a social psychological model of the structure of scholastic performance. It is argued that the grapho-phonic skills taught by the reading teacher, plus the continued within-class development of the child's syntactic structures and semantic codes seem to constitute the primary verbal reasoning processes. The development of these strategies involves the ability to react to what is read through checking validity, evaluating, making inferences, and drawing conclusions. It is this reading as reasoning which accounts for the differences in the subject-matter performances of a nationally representative probability sample of English 14-year olds, to a much greater degree than any other known factor. Thus, the research showed that reading comprehension is a common cause of science and literature achievements. The socioeconomic circumstances of English children did not directly affect their subject-matter performances; rather background factors were mediated by verbal ability and reading comprehension. Girls outperformed boys in literature and boys outperformed girls in science, but the evidence showed that the net disadvantage to girls in science was less than the net disadvantage to boys in literature. It was demonstrated that in England the "fixed" inputs of scholastic performances are less powerful than the controllable determinants such as reading comprehension; and that, therefore, teachers may be legitimately expected to assume greater responsibility for the scholastic performances of children than heretofore.

1. INTRODUCTION.

Reviewers of the epic studies by analysts of the International Association for the Evaluation of Educational Achievement (IEA) are agreed on two matters.[2] First, there is consensus regarding the theoretical and practical importance of cross national studies which are concerned with the identification of those characteristics of schools, teachers, the curriculum, and family environments which have significant consequences for the cognitive, affective and conative outcomes of schooling. Secondly, there is general agreement that the research findings provide educators with the evidence, validated cross-nationally, for discarding or de-emphasizing those practices which bear little or no relationship to the desired outcomes of schooling, or with the evidence for emphasizing practices which relate significantly to the attainment of these outcomes. Though the act of cleaning out the educational attics was a monumental achievement, the next generation of researchers is confronted with a new dilemma. On the one hand, outworn myths and traditions no longer stand in the way of research progress; while on the other hand it is apparent that educational problems do not lend themselves to the kind of simple one-way uni-causal solutions suggested by some educators in the 1950s and 60s.

The objective of this study is to present a systematic analysis of the structure of scholastic performance. In particular, the effect of reading comprehension, or verbal reasoning, as an intervening variable in a general model of scholastic performance for English 14-year olds will be examined. The thesis is held, that the processes of scholastic achievement in the specific subject-matter areas of schooling reflect the dynamics of individual resource acquisition; that the essential resources include verbal and reasoning abilities; and that by analyzing the patterning

of these resources, the conditions that affect them, and their consequences in terms of the multiple cognitive outcomes of schooling, greater leverage may be gained concerning an understanding of school performance variability. It will be apparent throughout the analysis that we are indebted to earlier IEA analysts in our efforts to formulate a general model of the structural manifestations of the process of scholastic achievement.

Several of the research findings we report have significant implications for school policy making and action programs directed at within-system, and within-school resource allocation practices. For example, the research indicates that the inferior scholastic performances of some individuals are primarily due to their inferior reading abilities or to other factors. Examination of model parameters reveals whether reading programs would suffice or whether other social actions are necessary to affect the performance opportunities of individuals. We hope that the model to be presented will clarify partisan controversy and help the concerned public formulate action programs for equalizing opportunities for scholastic excellence, though we do not address ourselves to the implications of the findings in detail.

From time-to-time the theme that many of the commonly accepted models of the process of scholastic achievement are seriously misspecified will be referred to. The specification error in question is <u>not</u> that important variables are necessarily omitted from these models; rather that their functional forms are misspecified. In particular, inferences made in studies concerning the relative effects of model components (e.g., the relative effects of home background factors and school related factors in

relation to other clusters of variables in the typical Coleman-Peaker model) may be erroneous in asymmetric research designs.

Over and above primary interest in reading as an intervening variable, three other issues will be examined. First, the relationship between socioeconomic factors and school performance (including reading) will be reassessed. Second, in addition to ascertaining differences in levels of performance attributable to sex differences, the question as to whether the actual process of achievement is different for boys than for girls will be raised. Thirdly, the question of the degree to which home background effects are subject-specific will be examined.

2. THEORY.

(i) Conceptual Framework.

From a social psychological perspective where the individual is the unit of analysis, schools and classrooms may be regarded as interpersonal interaction settings where student personalities are modified and transformed in an opportunity structure designed to optimize performances in those cognitive and affective outcomes of schooling considered morally desirable within the national culture. Teachers within these environments have mandates for intentionally administering those treatments which through approved and recognized procedures, are designed to initiate the child into the thought forms and moral behaviours which have received societal approval. The knowledge base and value orientations acquired as a consequence are intended to enable the individual to function in a relatively autonomous manner in the wider community - national and international.

The schools, however, are secondary socializing institutions because their inputs in terms of student traits or personality resources are predetermined as a function of home socializing effects. The net result is that the children entering each year of school do so with different levels of those resources required as prerequisites to successful performances during the year. In the general case, the greater the resource assets of the pupil in terms of coping with the progressively more complex environments of the school - especially in terms of subject-matter complexity - and the more effective the teacher treatments in these settings, the greater the probability that the individual will receive preferred treatments in the different settings at later grade levels.

At each stage of the cycle, student resource assets are transformed or converted into additional resource assets. These additional assets are the basic resources for subsequent transformations at the next stage of the cycle and so on. The process of resource conversion invokes a cumulative asset hypothesis - the obverse of Deutsch's (1965) "cumulative deficit hypothesis", (Deutsch, 1965; Whiteman and Deutsch, 1968; Whiteman, Brown and Deutsch, 1967). Though these personality-environment interactions are usually additive (Hunt, 1975), multiplicative interactions are theoretically possible (Cronbach and Snow, 1969; Berliner and Cahen, 1973), and have been demonstrated empirically (Bulcock, Fagerlind and Emanuelsson, 1974b; Fagerlind, 1975; Bulcock, 1975). In the multiplicative case, the resource conversion setting provides the relatively advantaged individual - such as the able and highly motivated pupil - with opportunities for gaining disproportionately greater advantages over individuals lacking such resource. In societies where such advantages are promoted through elitist policies and systems it has been

argued that the distribution of talent may well approximate a "Pareto-like" distribution (Lydall, 1968).

In this study our foremost concern is with the relation of reading comprehension as a school dependent resource (Asheim, 1956) to two logically different schooling outcomes - literature and science achievements. The consequences of the initiation of the pupil into the aesthetics of literature are expected to be increased familiarity with the elements of the major literary forms - poetry, drama, the novel, and biography - an awareness of the national literary heritage, an appreciation of literary craftsmanship, an intrinsic and enduring interest in literature, and the development of empathic understanding through mental experiments and vicarious experience. Initiation into the logic and substance of science is minimally expected to involve acquainting the student with the basic content and concepts of the natural science disciplines; to provide an intuitive grasp of the logic of experimentation through simulated procedures of discovery; and an appreciation of the role of science in the service of mankind. The resource outcomes of these curricular treatments - scientific rationality, critical appreciation, and empathic understanding - may be as desperately needed internationally as they were nationally a century ago. Models of man designed to account for such human resource outcomes simultaneously rather than one at a time, require little further justification than that they represent tests of our self-awareness, and help promote rational decision-making.

As discussed thus far the model has four components: two resource conversion settings - the home and school - and their respective outcomes - verbal ability as a function of home environment influences, and reading,

literature, and science achievements as functions of curricular treatments within school settings. The relationships are presented diagrammatically in Figure 1.

Figure 1 about here

Three equations capture the flow of effects in the conceptual model. First, verbal ability is represented as a function of the effectiveness of the home's resource conversion mechanisms which on the basis of social learning theory were described by Williams (1973, 1975a) as follows: (a) the opprotunity structure, or the opportunity that children have at home to learn and practice school-related skills; (b) the role model structure, or the extent to which the parents assume responsibility for their children's learning behaviour; (c) the reinforcement structure, or the sanctioning system of the home on a coerciveness continuum; and an expectations structure, or the extent to which parents constitute a source of significant other influence. Path "b" in Figure 1 captures this relationship. A serious limitation of contemporaneous social psychological studies of the school achievement process, or career attainment, is that accurate measures of these home environment dimensions (cf. Harris, 1969:1071-72) are unavailable, leaving the analyst with little alternative but to use surrogate and proxy measures such as job status of household head, parental education, family income and family size.

Second, the school environment is represented as a function of both home environment (path a) and verbal ability (path c). Mounting evidence suggests that verbal ability is a major intervening variable determining curriculum placement and grades through mediation of the effects of

family background structures (Yates and Pidgeon, 1957; Block, 1971, 92-93; Heyns, 1974, 1449). There is also growing evidence that the characteristics of the social environment are a function of the attributes of the individuals which compose it (cf. Coleman, 1958; 1961; Mcdill and Rigsby, 1973). The effect of verbal ability on school outcomes are expected to be both powerfully direct (path e) and indirect via school environments (paths c-f) as noted by Bulcock and Finn (1975:92).

Thirdly, the multiple cognitive outcomes of schooling are depicted as a function of all three predictor components. There are three direct effects (d, e, and f), and three indirect effects (a-f, b-c, and b-c-f).

The analyst's task is to formulate the best-fitting auxiliary model to this conceptual framework in order to render the hypotheses falsifiable. Notwithstanding contrary claims (e.g. Brodbeck, 1959), we hold the view that complete isomorphism between the conceptual model and man-made or operationalized representations of it is unattainable. In the following two subsections modifications to the conceptual model necessitated by the nature of the data base are attended to, and incongruities between the conceptual and main theory elements are acknowledged..

(ii) The Thorndikes' Postulate.

The dependence of school performance in subject matter outcomes on basic reading skill has been demonstrated in several recent studies; and in this regard there has been a revival of the earlier interest in reading and achievement in the content fields (Gray, 1925; Laffey, 1972). For example, Hauser (1971:77-80) showed that the reading comprehension of Tennessee high school students was a powerful intervening variable mediating the distal effects of family background factors and mathematics as a "central" outcome. Robert Thorndike (1973:169) has noted that the prediction of science and literature is mediated by reading comprehension and has postulated that reading has a central role as a predictor agent

for more specific subject-matter areas. Similarly, Bulcock and Finn (1975) in a causal model explaining performance in literature have demonstrated the effectiveness of reading as a mediating mechanism. Finn and Mattsson (1974) have, similarly, examined the predictive power of verbal skills in a multivariate model of four subtest performances in science; namely, physics, chemistry, biology, and practical work.

Though these studies have demonstrated empirically the utility of reading and verbal abilities (i.e. decoding skills) as crucially important intervening variables in models of specific subject-matter outcomes (encoding skills); as explanatory schema they are relatively underdeveloped. The notion of reading as a resource asset, even though grounded in the earlier writings of Huey and E.L. Thorndike, has received little attention. The past decade in reading research, however, has witnessed notable changes in both methodology with emphasis on model building (Davis, 1971), and theory, with emphasis on syntactic and semantic considerations as the psycholinguistic basis of comprehension (Carroll, 1970, 1971; Goodman, 1969, 1970, 1972; and R.L. Thorndike 1973-74). This shift in emphasis from reading as a one-to-one relationship between grapho-phonic skill and comprehension - that is, from reading conceived narrowly as a series of careful visual perceptions - to reading as a highly integrated and complex multifactor process, may account for a renewed interest in the more classical treatments of the reading process (cf. Carroll, 1968).

Kolers (1970) noted that the visual components of reading were overstressed at the expense of syntactic and semantic considerations. Hochberg (1970) and Hochberg and Brooks(1970) point out that through the utili-

zation of syntactic and semantic codes, and peripheral vision, skilled readers fixated only on those parts of a visual array that facilitated feedback or "guesses" about what was being said, and which assist in extending and anticipating meaning. Such processes underlie the notion of "reading as reasoning" or more specifically, reading as verbal reasoning; that is, as a resource asset, convertible into additional assets such as encoding performances in specific school subjects. This notion of reading is congruent with the description provided by E.L. Thorndike (1917:323) as:

> "... a very elaborate procedure, involving a weighing of each of many elements in a sentence, their organization in the proper relations one to another, the selection of certain of their connotations and the rejection of others, and the co-operation of many forces to determine final responses."

This notion has been developed and extended by R.L. Thorndike (1973-74:135) into the following postulate: "... reading is primarily an indicator of the general level of the individual's thinking and reasoning processes rather than a set of distinct and specialized skills". Thus, reading as reasoning or as a personality resource may on a priori grounds be regarded as a common cause of multiple, cognitive, schooling outcomes, which intervenes between them and the home environment resources of children. The principle will be referred to as the Thorndikes' postulate.

(iii) Main Theory.

The implications of the Thorndikes' postulate for the theory underlying the structure of scholastic performance are quite profound, though the isomorphism between the social psychological level of analysis and psycholinguistic theory is far from congruent in every respect. Neverthe-

less, one may infer that children exposed to relatively complex home socializing environments, in which there is adequate opportunity to verbally interact with highly articulate significant others, will likely develop more precocious oral language skills than their less advantaged peers (Anastasi, 1956; Jensen, 1968; Spaeth, 1975). By the same token, one might infer that the importance of early language learning for intellectual growth is more likely to be stressed and recognized by well-educated mothers (cf. Levenstein, 1975). Thus, it may be anticipated that, other things being equal, well-educated mothers will be more conscious of, and skillful in, the transmission of those primary learning elements which are the basis of the grapho-phonic, syntactic and semantic cueing strategies required for decoding precocity, than their less well-educated counterparts.

The social psychological structuring of these reading comprehension processes minimally involves an examination of the impact of parental education (especially the mother's in industrial nations), the home opportunity structure, and the socioeconomic structure of the home. It may be helpful to conceive home opportunity structure as, (i) the opportunity provided at home for the child to acquire and practice verbal skills - a variable partially subsumed by the proxy "family size" - and (ii) the opportunity provided at home for the child to practice such school relevant skills as prepositional relationships - a variable subsumed by the proxy measure "verbal ability" which is, in turn, an indicator of the child's ability to understand instruction. It may also help in this reification process to conceive the socioeconomic variable as a proxy for home environment complexity and, hence, a measure of the child's environmental advantage.

These social and psychological indicators, then - socioeconomic status, parental education, family size, and verbal ability - are merely measured estimates or crude proxies for the fine-grained psycholinguistic processes accounting for reading performance. A diagram of the hypothesized relationships is presented in Figure 2. It will be noted that the usual

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Figure 2 about here

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conventions employed in causal models are adopted. Cause-effect relationships are shown by arrows linking cause and effect; causally unanalysed relationships are shown by curved lines; and variation unexplained by within-model components is accounted for by residual effects or disturbances outside the model.

Effectively, Figure 2 represents a network of hypotheses which are falsifiable. There are four source or exogenous variables in the system. Though it is postulated that these are related, no causal ordering is hypothesized. There are four endogenous or within-system variables - two criterion measures of different subject-matter performances, and two intervening variables - and four residual effects - namely, the X_5e_1, X_6e_2, X_7e_3, and X_8e_4 relationships. In the case of X_6e_2, the relationship informs the reader that <u>not</u> all the variation in reading comprehension is accounted for by the source variables and verbal ability; rather, some is attributable to unspecified variables which were not included in the model.

An analysis of the relative effects - both direct and indirect - of the predictor variables in each segment of the model would require the solution of four equations.

a. Verbal ability as dependent variable; the four source variables - father's occupational status (X_1), parental education (X_2), number of children in the family (X_3), and the respondent's sex (X_4) - as independent 1

b. Reading comprehension as dependent; the source variables, and verbal ability as independent 2

c. Literature achievement as dependent; the source variables, verbal ability, and reading comprehension as independent 3

d. Science performance as dependent; the source variables, verbal ability and reading comprehension as independent 4

Equations one and two deal with the reading process component. First, verbal ability is accounted for by background factors. For example, the P_{51} relationship is premised on the belief that SES is a proxy for home environment advantage. Thus, children from higher SES backgrounds are predicted to have those resource assets, both on school entry and at subsequent age-grade stages, which will enable them to capitalize on the opportunities provided by the within-class, within-school environments, other things being equal. The ceteris paribus rider is extremely important; and in this model (Figure 2) refers to the remaining source variables.

The P_{62} relationship is expected to operate over-and-above the effects of X_1 (FATHOCC). The parent's education is designed to reflect the abilities of the parents; but because the measure is usually based on the number of years of formal schooling received or educational attainment, rather than the quality of schooling or educational performance, the effectiveness of the variable is likely to be diminished. Thus, parental education may be a seriously underestimated factor; which, nevertheless,

cannot be ignored. Neither can the effect of the SIBSZ variable be ignored even though, it too, may be a particularly weak surrogate for the frequency and intensity of parent-child verbal interaction. The modest, but persistent, negative effects of the number of children in the family are well-established in the literature (Duncan, 1968; Bulcock, Fagerlind, and Emanuelsson, 1974a).

Since the references to sex differences in the cross-national education literature by Bloom (in Husen, 1967, Vol. 2, 233-250), the effect of sex has been given more serious and detailed attention (Boocock, 1972, chap. 2; Dwyer, 1973). In some subject areas sex differences are sources of controversy (cf. McCullough, et al., 1974, p. 410; and Downing and Dalrymple-Alfrod, 1974-75, pp. 216-217). Questions such as the following, then, have become pertinent. Are the advantages to boys in science (Comber and Keeves, 1973:256-267, 291-292) about equal to or different than the advantages to girls in literature (Purves, 1973:159-169)? Are advantages to girls in literature attributable to their modest superiority in verbal ability and reading comprehension as postulated by Dwyer (1973) in her review of the U.S. literature? And if girls are advantaged in terms of reading, and if reading as reasoning provides advantages in science performance as the Thorndikes' postulate suggests, are girls likely to be relatively less disadvantaged in science performances, than boys are in literature performances? The structural equation approach adopted in this study will shed light on these issues.

Equations four and five accounting for variability in literary understanding and science performance respectively are problematic on two counts. First, there is the question regarding the relative effects of home environment factors in relation to school influences. Secondly,

there is the question of whether performances in literature and science are attributable to common causes as hypothesized, or whether the relationship between the two criteria measures is reciprocal.

The research supportative of the thesis that the schools are class biased, in that how well students perform is more a function of home background factors than ability and motivation, has been either historical in a history of ideas or sociology of knowledge framework (Katz, 1971; Carnoy, 1974) or based upon asymmetrical research designs which have preferred the partitioning of R^2 type of explanation (e.g., Coleman, et al., 1966; and IEA monographs). In a precise and probably definitive criticism of this approach, Duncan (1975:65) has noted that "The problem of partitioning R^2 bears no essential relationship to estimating or testing a model, and it really does not add anything to our understanding of how a model works. The simplest recommendation ... is to eschew altogether the task of dividing R^2 into unique causal components".

For some time there have been studies which failed to provide support for the class bias explanation of schooling performance (Hauser, 1971; Williams 1972; Heyns, 1974). More recently a number of analysts in Canada and the U.S. have shown that a meritocratic thesis may provide a more realistic account of the way in which schools operate in these countries (Rehberg and Rosenthal, 1975; Bulcock, 1975; Williams, 1975b). The class bias thesis, however, may still represent a viable explanation of variables in school outcomes in England since it is only in the recent past that comprehensive school reforms have been superimposed on many formerly elitist-type systems at the county and borough levels.

The second problem concerning the extent to which the co-relation between literature and science is a function of a common cause will be examined by invoking the Thorndikes' postulate. Verification for the postulate will depend on whether the effect of reading, as reasoning, will attenuate or eliminate the covariation between criteria measures. In this manner credence will be gained for the central theme of this research, that reading is an important intervening variable in the general model of the structure of scholastic performance.

3. DATA AND METHOD.

(i) The Sample.

Data for this study came from an extensive questionnaire survey conducted by the National Foundation for Educational Research in England and Wales in 1970 as part of the IEA survey of achievement in reading, literature, and science. The subjects of the study are the 3,284 14-year old boys and girls randomly selected through the application of a sampling frame (cf. Bloom Report 1969, 9.9-9.12 for details). Scientific parsimony and generalizability calls for stratified probability samples in which each member of the population has a known non-zero chance of selection. On the basis of such sampling procedures the design effects (Peaker, 1975) may be accurately estimated thereby providing the analyst with an estimate of the confidence with which he may make inferences from the sample findings to the general population - in this instance the population of English 14-year old school children. Since these matters have been taken up in detail by Peaker, the IEA International Sampling Referee, suffice it to say that the evidence supports the conclusion that the findings may be generalized to the wider population of English school children.

The 1970 survey was designed to gather information on the reading comprehension, literature and science performances through instruments designed to be cross-culturally valid and accurate. Approximately 25-30, 14-year olds in each school out of the approximately 110 schools sampled in each of the fifteen participating countries, were randomly selected as respondents. In addition to writing achievement tests in the three subject-matter areas, students completed questionnaires which provided background and attitudinal information. Classroom teachers and headmasters also completed survey questionnaires. The upshot is a massive IEA data archive which, if test score information is included, contains about 1,200 separate items of information on each student.

The questionnaires, though specifically designed to gather information on the determinants of variability in three subject-matter areas from country to country, were of the omnibus variety and provide information on a variety of problems and issues, both practical and theoretical, related to educational achievement. Detailed descriptions of the samples, the instrumentation and the general findings are available in the IEA monographs and the numerous national level studies conducted in each of the participating countries. Operational definitions of the variables are presented next.

(ii) Variables.

X_1 FATHOCC - Father's occupational prestige. Each national center participating in the stage two, three-subject survey was asked to design their own occupational status scale on the basis of whatever national norms were considered most valid. In England the standard procedure was

adopted in which professional and managerial occupations were ranked in categories 9, 8, 7; skilled workers in categories 6, 5, and 4; and semi-skilled and unskilled workers were classified into the remaining 3, 2, 1, categories. The means, standard deviations and other descriptive measures for the FATHOCC variable are presented in Table 1.

X_2 PARED - Parental education. A simple additive combination of mother's and father's education was used as the estimate of parental education. Each variable was composed of five categories: 0 years, 1-5, 6-10, 11-15, and greater than 15.

X_3 SIBSZ - Number of brothers and sisters. This variable was operationalized by the question on the student questionnaire: "How many brothers and sisters have you?" There were five response categories: 0, 1, 2, 3, 4 or more.

X_4 SEX - Respondent's sex. The sex variable was scored "1" for males, "2" for females. It is important to note that it is not the biological dichotomy "sex" that is the causal variable of interest; rather it is an indicator or reflector of sets of experience which differ for the two sexes. Since these experiences will not assume identical values for all males or all females the variable is only vaguely identified and not adequately measured. This lack of measurement precision constitutes a limitation; and particularly in so far as policy inferences are concerned.

X_5 VERBAL - Verbal ability. One of the subtests used in stage two testing in England was known as the word knowledge test. The position taken in this study, which is supported by Thorndike (1973, p. 36), is that the scores on this test, after correction for guessing, represent accurate estimates of the students' verbal abilities. Though there was

some variation in test scores from country to country - probably as a function of shifts in the discriminatory power of some test items after translation from the English - the within-country discrimination was very satisfactory. Thus, for the English sample, after correction for guessing, the K-R 20 formula for reliability (Kuder and Richardson, 1937) generated a coefficient of .833.

X_6 RDGCOMP - Reading comprehension. Considerable care was taken by Thorndike and his International Reading Committee (Thorndike, 1973: Chap. 2) in the construction of a reading comprehension test. The version used was of the conventional variety - a reading passage followed by multiple choice questions on the passage - and was designed to cover a wide range of reading skills. The K-R 20 formula provides a reliability coefficient of .887; high enough to permit useful studies of individual correlates of the score.

X_7 LIT - Literature achievement. The criterion measure for literature was determined by scores on the IEA literature test designed by the International Literature Committee (Purves, 1973: Chaps. 2 and 4). Multiple choice questions were used to assess the student's ability to read a literary work, such as a story, critically. There were two classes of test items: those dealing with literary comprehension, and those measuring skill in literary interpretation. Seventeen to 19 questions were asked on each of two stories. Ten questions were interpretive and the remainer concerned with literary comprehension. After correction for guessing, the K-R 20 reliability was .83.

X_8 SCI - Science achievement. The test items and the test construction procedures of the IEA science committee are described in Comber and Keeves (1973), chapter 2 and the Appendix). The overall science test

score for each child was based on an additive combination of four subtest scores in physics, chemistry, biology, and practical work. About ten questions were related to each subtest area in order to allow a reasonable level of subtest reliability to be reached. A K-R 20 level of .89 was reached on the one hour test. The descriptive statistics for the components of the general model of the structure of scholastic achievement are presented in Table 1.

Table 1 about here

(iii) Caveatae.

Several limitations of the research design have been referred to:- a lack of congruence between the social psychological model tested and the underlying psycholinguistic processes; measurement difficulties related to variables such as sex, and other specification problems. It is necessary to acknowledge that, despite all reasonable precautions and care in test administration, there are limitations to questionnaire data gathering procedures. Some responses may not be accurate and some inaccuracies may be non-random, thereby accounting for systematic but unknown, biases in the dispersion measures. Though the structural equation procedure is robust (cf. Gardner, 1975), where systematic bias exists (Bulcock and Finn, 1975: appendix) erroneous conclusions may be drawn from parameter estimates, and under some circumstances high levels of measurement error can unwittingly prevail (Namboodiri, et al., 1975:475-481).

Though care was taken in the causal ordering of predictor variables, and though objective behavioural measures were preferred to subjective psychological ones, not all the measurement difficulties are resolvable

in these ways. For example, an essential assumption that must be met by any structural equation model reads as follows: there shall be no ambiguity in the causal orderings of the variables.[3] Though causality may be theoretically established using the classical experimental design (Stouffer, 1950; Campbell and Stanley, 1963) such methods are seldom possible in sociology. The causality assumption in sociology, then, is dependent on longitudinal research or panel designs where the same analytical units are measured at several points in time. Such research, however, is costly in terms of both financing and time; therefore, there are few longitudinal data sets available.

Since IEA data is not longitudinal it is apparent that in the strictest sense the causal assumptions underlying our general model may not be warranted. On the other hand it seems plausible to the investigators that bio-social variables such as sex and age are prior to most attitudinal, opinion, and achievement now (i.e., at the time of the survey) items. It also seems plausible that the natural cycle ordering of the grandparent-parent-child variety justifies the placement of background factors and events such as FATHOCC, PARED, and SIBSZ prior to outcomes dependent upon more recent events and experiences. By the same token, it seems plausible to assume that verbal precocity is acquired prior to reading precocity; and that in the English school system an acceptable level of reading comprehension must be attained before the formal teaching of literature and science is undertaken.[4]

It is our judgment that few survey research studies have been designed with greater care than those designed and conducted by IEA analysts; that the experience gained will result in more rigorous designs in future

research; and that given the state of the art in the late "'60s" most known procedures for minimizing error were taken. Nevertheless, though care is taken in marshalling and presenting the evidence, on the basis of which conclusions will be drawn, the analysis does not liberate the reader from the necessity of exercising independent judgment and a healthy scepticism.

4. RESULTS.

Zero-order correlations, means and standard deviations of the eight variables for the total sample are presented in Table 2. The inter-correlations or gross effects provide one basis for evaluating model relationships depicted in Figure 2. It will be noted that, in general, the coefficients are in the hypothesized direction - all are significant at the $p < .001$ level.

Table 2 about here

The structural coefficients for all the paths in a fully-identified model are presented in Table 3. The magnitude of the coefficients provide support for the hypotheses depicted diagrammatically in Figure 3. The Figure 3 parameters were estimated after the deletion of those paths in

Table 3 about here

the model which proved to be of negligible significance. In this instance, those paths with standardized coefficients less than .05 were omitted from the reestimated equations. Decisions of this kind correspond to conventional practices in theory trimming (Duncan, 1966; Heise, 1969) which are

aids facilitating the goal of scientific parsimony. It will be noted that the residual effects remain relatively unchanged after the reparameterization, which is a rough guide to the mathematical accuracy of the more parsimonious model.

Figure 3 about here

Several analysts have noted that the gross or total effect of a relationship between two variables, as represented by their zero-order correlation, may be decomposed into a number of independent elements (e.g., Finney, 1972; Charner and Cohen, 1973; Alwin and Hauser, 1975). The resultant decomposition may be illustrated as follows:

GROSS EFFECT = NET EFFECT + INDIRECT EFFECTS + NON-CAUSAL COMPONENTS
(total causal effects)

where:

GROSS ..... = r_{ij}

NET EFFECT ..... = p_{ij}

INDIRECT EFFECTS ..... = the sum of n stage paths with intervening variables.

NON-CAUSAL COMPONENTS ..... = the sum of the effects attributable to other independent variables either temporally simultaneous with (e.g., source variables) or antecedent to the independent variable of interest.

The first two elements to the right hand side of the equation - the net or direct effect and the indirect effects - represent the total causal

effects (TCEs). The TCEs of all the predictor variables in the model are presented in Table 4. The utility of the total causal effects lies in

Table 4 about here

the fact that they represent exact estimates of the total relative impact of explanatory variables on the outcomes of interest. They may be ranked for comparative purposes as in Table 5. The magnitude of the total causal

Table 5 about here

impact may be noted from Table 4 and the rank order of magnitude noted from Table 5. With the exception of the modest TCEs of PARED and SEX on VERBAL, and a TCE of less than .1 for SEX on RDGCOMP, the TCEs of predictor variables at each model segment are greater than .1; that is, in our judgment, both substantively and statistically significant.

A final item of interest concerns the extent to which the antecedent variables account for variance in literature and science. For the total sample the model accounts for 63 per cent of the variance in literature and 58 per cent of the variance in science. Obviously, the model is an effective one for explaining specific subject-matter performances.

5. DISCUSSION OF FINDINGS.

(i) The VERBAL Segment.

The finding that source variables, except sex, are related to verbal ability is consistent with those of others (Jencks, et al., 1972, p. 339; Fagerlind, 1975, pp. 57-66). A rough estimate of these similarities may

be made by comparing path coefficients. Thus, the effects of FATHOCC on early ability were .200, .205, and .285 for the U.S. (Jencks, et al.) Swedish (Fagerlind) and English (present study) data sets respectively; the effects of PARED (or father's education in the U.S. and Swedish data) on early ability were .200, .110, and .099 for the same data sets; and the relationship between family size and early ability was -.123 in Sweden and -.168 in England. The SIBSZ variable was not used in the Jencks' study. The early ability residuals were also similar - .940 in the U.S. study, .943 in the Swedish study, and .919 in the present study.

These findings are regarded as prima facie evidence for the thesis that the verbal component in the English data set corresponds to the verbal dimension that always emerges as the first principal component in any factor analytic disaggregation of variability in mental ability scores. The fact that the structural similarities are cross-national ought not to be overlooked in view of the contention that the explanatory schema represents a general model of scholastic performance.

The present study is the first one in which the total causal effects of predictor variables in educational performance models have been calculated. From Table 4 one notes that in England the socioeconomic variable FATHOCC emerges as the most powerful predictor of the verbal abilities of 14-year olds. It is three times as powerful as parental education level and half again as powerful as the number of children in the family. The sex variable (beta = .037) was not considered of substantive significance insofar as verbal ability was concerned. Since PARED is controllable in the long run - e.g., from one generation to another - by state-wide resource allocation practices designed to control

school withdrawal rates, it may be disappointing for egalitarians to note its relatively modest influence. As noted above, however, the educational attainment measure used is a crude estimate of educational performance; therefore, the magnitude of the relationship may be seriously underestimated.

(ii) The RDGCOMP Segment.

The "reading as reasoning" perspective is congruent with the pronouncements of the psycholinguists. In the mid-sixties Goodman (1965) was pointing out that reading involved a transformation of the visual through interaction with the reader's extant experiences which generated "comprehension". Carroll (1970) noted that the ability to react to what is read through checking validity, evaluating, making inferences, and drawing conclusions, constitutes "thinking" and "reasoning". These transformations which are referred to as the processes of resource conversion in this paper take place in all reading contexts but are formally learned and developed in school classrooms. Though the school conditions supportative or suppressive of resource conversion phenomena are not identified, the extent of the dependency on family background factors, sex, and verbal ability is estimated.

Of these antecedents, verbal ability is by far the most important determinant of reading comprehension. From Table 5 one notes that it is twice as powerful as the socioeconomic variable FATHOCC (Beta = .640 vs. .294); that it has four times the impact of any other variable in the model segment; and that the predictors of reading account for in excess of 50 per cent of the explained variance. Since verbal ability is probably

a proxy for the student's ability to understand instruction (Bloom, 1971a), and in this connection probably a determinant of conative outcomes of schooling such as motivation and perseverence (Carroll, 1963; Bloom, 1971b), the importance of early school language and reading readiness programs becomes readily acceptable.

The effects of sex are not readily apparent unless one examines its total causal effect. Thus, the direct effects of sex on reading are inconsequential, and so are the indirect effects taken separately; but the two together (the TCEs) are not negligible in so far as English 14 year olds are concerned. Clearly the relationship is more subtle and complex than earlier analysts have noted.

(iii) The Criteria Measures Segment.

a. Reading as an Intervening Variable.

What evidence stems from the results of the analysis supportative of the Thorndikes' postulate? To what extent are the multiple subject-matter outcomes of schooling a function of reading as reasoning; that is, of a common cause? There are three sources of evidence for answering these questions; all of which support the hypotheses generated by resource conversion theory.

First, the p_{76}, p_{86} coefficients in Figure 3 demonstrate the relative impact of reading as an unusually powerful predictor of scholastic performance in literature and science. Coefficients of this magnitude ($p_{76} = .631$ and $p_{86} = .574$) are usually only found in panel designs where the relative effects of a variable such as early mental ability at time one may reach the Beta = .6 range in terms of its causal impact on later

mental ability at time two. The VERBAL variable has the next most powerful effect, but much of the force of this variable is mediated by the reading component. Both VERBAL and RDGCOMP mediate the effects of all source variables except sex.

Second, when the mediating effects of reading comprehension, verbal ability, and sex are partialled out of the literature-science relationship, the level of association is reduced to insignificance (r_{78} = .587; compared to $r_{78.456}$ = .102). Thus, the association between scholastic performance criteria measures is a function of a set of known common causes of which the single most powerful cause is reading.

Third, the TCEs of VERBAL and RDGCOMP on the criteria measures confirm these conclusions. Table 5 shows that reading ranks first in TCE magnitude on literature (TCE = .635) and second in TCE magnitude on science (TCE = .548). VERBAL ranks second in terms of magnitude on literature (TCE = .572) and first in magnitude on science (TCE = ,573). In third order of effect on both literature and science is the socio-economic factor, FATHOCC, (TCEs = .256 and .231 respectively) but the magnitude of FATHOCC effects are less than half those of either VERBAL or RDGCOMP as intervening variables.

The evidence seems clearcut. Reading as reasoning does operate as a powerful common cause of literature and science outcomes considered simultaneously. When combined with verbal ability and differences in performance attributable to sex, the level of association between literature and science is reduced to insignificance.

b. Socioeconomic Status and School Performance.

Purves (1973, p. 63) shows that "home background" or socioeconomic factors in England account for about 38 per cent of the explained variance in literature compared to about 18 per cent for reading, or 27 per cent of the explained variance for reading and verbal ability combined. Comber and Keeves (1973, p. 261) show that "home circumstances" or socioeconomic factors in England account for 38 per cent of the explained variance in science ((home circumstances (R^2 = .20)/total variance accounted for (R_2 = .52) x 100). Such results are consistent with the thesis that English schools are class biased institutions; hence, supportative of revisionist interpretations of education by social historians such as Michael Katz.

One advantage of the use of the structural equation model over the partitioning of R^2 procedure used by Purves, and Comber and Keeves is that it enables the analyst to go beyond mere concern with levels of association, or incremental R_2 explanations, to concerns revolving around within-system causal dependencies. Model symmetry facilitates the decomposition of gross effects into their causal and non-causal components. These advantages were recognized by IEA analysts in the research design period of the late 1960s, but technical problems stood in the way of constructing symmetrical block-type models at that time. In the interim, these technical difficulties have been overcome (Coleman, 1972:158-159) but not in time for IEA analysts to take full advantage of them.

Tables 4 and 5 do not support the unambiguous conclusions of IEA studies conducted on English 14-year olds, because there is little evidence for concluding that the schools are as class biased as formerly believed. Socioeconomic factors are still both substantively and statistically

significant, with TCEs of .256 and .231 in literature and science respectively. The effects of both parental education and number of children in the family are also significant, though more modest in magnitude. Nevertheless, each of these effects is still modest by comparison with the impact of verbal ability and reading as reasoning which is interpreted here as support for a meritocratic thesis; namely, that school performance is more a function of ability and motivational factors, than home background circumstances. Reading as a school dependent resource, is the most important of the "ability" factors.

c. Sex Differences.

Though the net effects of sex on verbal ability and reading are negligible (Table 3) the net effects on literature and science are powerful (betas = .179 and -.167 respectively). The effects of sex differences in TCE terms (Table 5) are greater than those of other source variables except father's occupational status. The important question, then, is whether sex differences are attributable to differences in levels of performance, or to differences in the process of scholastic achievement as noted in other studies (Alexander and Eckland, 1973, p. 680; and Spaeth, 1975).

The performance level differences are presented in Table 1 which shows that the mean performance differences (24.0 for boys vs. 25.9 for girls in reading; and 14.4 for boys vs. 15.9 for girls in verbal ability) are in favour of girls. These advantages seem to be reflected in the TCEs of sex differences on literature (TCE = +.216) and science (TCE = -.133) suggestive of the fact that girls are less disadvantaged in science than

boys are disadvantaged in literature. The case must rest, however, on whether there are similarities or differences in the structural parameters of the general model of scholastic performance based upon separate analyses. The relevant results of separate analyses for boys and girls are presented in Table 6. Comparisons between regression coefficients show that the effects of the VERBAL component for girls on both performance

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Table 6 about here

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outcomes are marginally stronger for girls; and that the effects of the RDGCOMP component on performance outcomes is marginally stronger for boys. Proportionately, however, girls have greater overall advantages, largely because of the more powerful effects of the VERBAL component on science than on literature. Since the girls are relatively more advantaged here than boys Table 6 may be read to read as follows: the advantages to boys in science preformance are relatively less than the advantages to girls in literature performance because the effect of the verbal ability component on science is relatively greater than that of reading comprehension on science, and the VERBAL-SCI relationship (Table 6) favours girls.

The returns, then, for the same resource conversion experiences are not the same for English 14-year old boys, as for English 14-year old girls. In aggregate these resource conversion experiences - particularly those stemming from home environmental experiences which account for early verbal precocity - tend to favour girls.

d. Home-School Dependencies.

One assessment of IEA research by Coleman (1973) has drawn attention to the supposed fact that some school subject matter achievements are more

home dependent than others. The results of the present study are not interpreted as providing unqualified support for such pronouncements:

> These data (the IEA monographs dealing with achievement in reading, literature, and science) show conclusively then, that reading achievement is more fully an outgrowth of home influences than are either the other two subjects (literature and science); less a function of what takes place at school. This is a rather important result, because it indicates that the general finding in this study and others that home background is a much more powerful influence than school influences in determining achievement is subject specific Not all subjects are alike in the mix of family influences and school influences that determines their achievement.

In the first instance, the TCEs in Tables 4 and 5 show that there is little difference between reading literature and science in terms of the degree to which they are influenced by the three home background source variables - FATHOCC, PARED, and SIBSZ. Perhaps reading is affected more by FATHOCC than either literature or science but the range of difference is only .061, hardly sufficient to support the "subject specific" home dependency argument.

In the second instance some clarification is necessary in order to avoid a pessimistic interpretation of the pronouncement that reading comprehansion is a home dependent variable. Since reading comprehension is little more influenced by home background factors than literature and science perofrmances, and since the class biased schools thesis fails to hold under close inspection, the problem revolves around the extent to which the VERBAL component is a fixed or noncontrollable resource element in the reading equation.

It is probably correct to infer that verbal abilities are initially a function of the effects of home resource conversion settings. It is also probably correct to infer that the verbal abilities of 14-year olds

have been influenced to some degree by within-school teacher treatments. There is, further, little doubt as to the relative magnitude of verbal ability as a determinant of reading, which is some three to six times greater than any other model predictor. If the verbal factor is one of the home dependent factors that Coleman was referring to, and if it is not amenable to within-school curricular treatments - e.g. language arts programmes - then the pessimism is warranted. There is evidence however, that graphc-phonic skills, syntactic structure and semantic control - the elements of reading strategies - are controllable by curricula treatments; and, therefore, grounds for rejecting Coleman's assessment.

(iv) Practical Implications.

An effort has been made to show the crucial role played by reading as reasoning in a general model of scholastic performance. The present evidence supports two conclusions which have important practical implications. First, the mandate that the primary and elementary school teacher has for teaching reading and the language arts has never been treated lightly. That this mandate should be continued to be taken seriously is borne out in this research, which shows that specific subject matter performances in literature and science are more amenable to school related influences than home dependent factors. Since basic reading skills are learned in the early grades of school, there are profound implications for the training of primary and elementary teachers.

Secondly, since reading as a school dependent resource mediates home influences on the cognitive outcomes of schooling, the implications for early school interventionist policies dealing with language and reading

remediation are also profound. One is reminded of the work of Malmquist (1970, 1972) in this regard, who has shown in Sweden how "more than 80 per cent of the cases identified as potential cases of reading disability at the beginning of grade one were prevented" (Malmquist, 1972, p. 148).

6. CONCLUSIONS.

The study represents an attempt to demonstrate the key role of reading as an element in a general model of scholastic performance in England. The study assessed:

(i) the magnitude of the effects of social background factors on literature and science in relation to the magnitude of other within-system factors;

(ii) the relative effectiveness of reading, as reasoning, as an intervening variable;

(iii) the rank ordering of the effects of model predictors;

(iv) the effects of sex differences on two different scholastic performance outcomes;

(v) the extent of the home dependency of school performances in reading, literature and science.

It was concluded that:

(i) The use of asymmetrical research designs by analysts in earlier studies may have resulted in the over-estimation of home background factors as determinants of scholastic performance.

(ii) Background factors affecting school subject-matter performances were mediated by two powerful intervening variables - verbal ability and reading comprehension.

(iii) The results of the analysis were interpreted as supportative of the Thorndikes' postulate, and the expository viability of the resource conversion approach.

(iv) There were not only sex differences in levels of subject-matter performance, but also sex differences in the process of school achievement for English 14-year olds. These differences in process accounted for an overall net advantage to girls.

(v) Though reading was marginally more dependent on home background circumstances than either literature or science, the difference was so small as to make questionable the claims of some analysts that some school subjects are more home dependent than others.

(vi) The thesis that the schools are class biased institutions did not hold up to close scrutiny in so far as subject-matter performance is concerned. Though socioeconomic factors were significant, their impact was several times less than that of more school manageable outcomes such as reading performance.

(vii) The fact that the academic performances of pupils are more controllable through within-school treatments than formerly believed, is interpreted as meaning that teachers, both individually and collectively, may legitimately assume greater responsibility for the intellectual efforts of students. The obverse of this coin may be more constraining in terms of prevailing practices; namely, that teachers may be held more accountable for the quality of service provided for their clientele.

(viii) Because reading is a crucially important resource mechanism in the structure of scholastic performance, it is concluded that no teacher is more important than the reading teacher, that no teachers are more important than the primary teachers; and that resource allocation policies would do well to reflect these realities.

NOTES

1. This research was made possible by research leave for the first author from Memorial University of Newfoundland 1973-74, and a Spencer Foundation research fellowship tenable at the offices of the International Association for the Evaluation of Educational Achievement (IEA), University of Stockholm. Our thanks are extended to the IEA Council for permission to analyze archive data. The opinions expressed in this publication do not necessarily reflect the position, policy, or endorsement of the Spencer Foundation or IEA. Appreciation is extended to Memorial University of Newfoundland for their generous support of computer usage.

2. IEA was incorporated in 1967 under Belgian law. It is a non-profit, non-governmental organization which undertakes educational and related research on an international scale in order to examine educational problems common to many countries, and in order to provide evidence which can help the improvement of educational systems.
   Major studies by IEA analysts include Husén, (ed.) vols. 1 and 2 (1967); the Bloom Report (1969); Comber and Keeves (1973); Purves (1973); Thorndike (1973); Carroll (1975); Peaker (1975); Torney et al. (1976) coming); Lewis and Massad (1975) ; Passow et al. (1976) (forthcoming); Walker (1976)
   Recent reviews of the 1973 monograph series have included: Berger (1974); Burton and Early (1974); Coleman (1973); Downing (1973); Downing and Dalrymple-Alford (1974-75), Early (1974); McCullough, Downing, and Heber (1974); Platt (1973, 1973-74); Voelker (1974).

3. One frequently encounters individuals with "hang ups" stemming from their freshman philosophy courses regarding the use of terms such as "cause" or "determine" by the social scientist (cf. Peters, 1958). If the reader is one of the individuals, inhibited by positivistic dogmas, little harm will be done by reading the word "cause" as: "having a statistical effect on X, over-and-above the effects of other antecedent variables considered simultaneously" (cf. Davis, 1971:6).

4. We agree that in scientific endeavours "plausibility" assumptions are not enough, but against this one must invoke the reality principle; failure to do so would virtually preclude the possibility of any mode of scientific enquiry. In this regard we are indebted to Gilbert Peaker who, in private correspondence, has drawn attention to parallel issues in the less prestigious days of inquiry in the physical sciences. Peaker reminds us of the earlier writings of Betrand Russell who has written that:

> "No doubt physics would like to forget its early history, which like that of many established institutions, is not so creditable as could be wished ... The whole process is one of tinkering. If common-sense estimates of distance and size are roughly correct, then certain physical laws are roughly correct. If these laws are quite correct, the common-sense estimates must be slightly amended. If the various laws are not exactly compatible they must be adjusted until the inconsistency ceases. Thus, observation and theory interact; what, in scientific physics, is called an observation is usually something involving a considerable admixture of theory." (emphasis added)

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TABLE 1

MEANS, STANDARD DEVIATIONS, SKEWNESS, KURTOSIS, AND CASE BASE OF VARIABLES INCLUDED IN THE GENERAL MODEL OF SCHOLASTIC PERFORMANCE IN ENGLAND, STRATIFIED BY SEX

	Total England (N = 3284)					English Boys (N = 1558)					English Girls (N = 1576)				
VARIABLES	$\bar{X}$	SD	Skew-ness	Kurt-osis	N	$\bar{X}$	SD	Skew-ness	Kurt-osis	N	$\bar{X}$	SD	Skew-ness	Kurt-osis	N
X_1 FATHOCC	3.1	1.8	.87	-.35	2965	2.9	1.7	.98	.00	1466	3.2	1.9	.75	- .65	1487
$X_{2.1}$ FED	3.3	0.7	-.05	1.24	3035	3.3	0.7	-.19	1.16	1495	3.4	0.7	.18	1.17	1537
$X_{2.2}$ MED	3.3	0.7	-.20	1.44	3036	3.2	0.7	-.20	1.29	1489	3.3	0.7	-.16	1.58	1544
$X_{2.3}$ PARED	6.6	1.3	-.23	1.43	3011	6.5	1.4	-.32	1.37	1478	6.7	1.2	-.06	1.36	1530
X_3 SIBSZ	3.2	1.3	.07	-1.22	3123	3.2	1.3	.07	-1.23	1546	3.2	1.3	.07	-1.21	1572
X_4 SEX	1.5	.5	-.01	-2.0	3134	-	-	-	-	1558	-	-	-	-	1576
X_5 VERBAL	15.0	9.6	-.13	- .23	3129	14.4	9.5	-.23	- .26	1551	15.7	9.7	-.05	-.23	1571
X_6 RDGCOMP	24.8	11.9	-.28	- .62	3061	24.0	11.7	-.33	- .56	1494	25.9	11.9	-.26	-.68	1507
X_7 LIT	15.8	8.3	-.24	- .73	2989	13.8	7.9	-.13	- .80	1437	17.8	8.2	-.45	-.46	1461
X_8 SCI	20.7	13.9	.77	.35	3078	22.3	14.5	.67	.09	1493	19.4	13.1	.85	.63	1494

TABLE 2

CORRELATIONS, MEANS, STANDARD DEVIATIONS, AND CASE BASE OF VARIABLES IN THE GENERAL MODEL OF THE STRUCTURE OF SCHOLASTIC PERFORMANCE[a]

VARIABLES	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	$\bar{X}$	SD	CASES
X_1 FATHOCC		2857	2946	2953	2948	2840	2756	2824	3.067	1.797	2965
X_2 PARED	.297		2998	3008	3001	2885	2794	2873	6.614	1.301	3011
X_3 SIBSZ	-.155	-.101		3118	3111	2992	2887	2977	3.195	1.300	3123
X_4 SEX	.078	.064	.001		3122	3001	2898	2987	1.503	.500	3134
X_5 VERBAL	.341	.201	-.222	.065		2999	2897	2983	15.004	9.624	3129
X_6 RDGCOMP	.351	.215	-.222	.080	.700		2908	2929	24.777	11.877	3061
X_7 LIT	.310	.202	-.184	.241	.623	.764		2845	15.756	8.347	2989
X_8 SCI	.307	.211	-.207	-.105	.627	.726	.587		20.743	13.864	3078

[a] Number of cases for correlation are above the diagonal; correlation coefficients are below the diagonal. The key to the mnemonics used is as follows: FATHOCC = father's occupational status; PARED = parental education; SIBSZ = number of children in family; VERBAL = verbal ability; RDGCOMP = reading comprehension; LIT = corrected score in literature achievement; SCI = corrected score in science (i.e., corrected for guessing).

TABLE 3

STRUCTURAL COEFFICIENTS FOR THE FULLY-IDENTIFIED MODEL OF SCHOLASTIC PERFORMANCE BY ORDINARY LEAST SQUARES: (I) REGRESSION COEFFICIENTS, (II) PATH COEFFICIENTS, (III) STANDARD ERRORS (N = 3284)

Independent Variables	DEPENDENT VARIABLES											
	VERBAL (X_5)			RDGCOMP (X_6)			LIT (X_7)			SCI (X_8)		
	I	II	III	I	II	III	I	II	III	I	II	III
X_1 FATHOCC	1.512	.2825	.0975	.7168	.1085	.0957	.0664	.0143	.0599	.2417	.0313	.1041
X_2 PARED	0.723	.0978	.1336	.4260	.0467	.1266	.1212	.0189	.0786	.4806	.0451	.1366
X_3 SIBSZ	-1.248	-.1686	.12914	-.5394	-.0590	.1237	-.0274	-.0043	.0769	-.2552	-.0239	.1336
X_4 SEX	.721	.0375	.3325	.6473	.0272	.3137	2.9684	.1778	.1944	-4.7055	-.1697	.3379
X_5 VERBAL				.7881	.6386	.0176	.1422	.1640	.0143	.3215	.2232	.0248
X_6 RDGCOMP							.4391	.6248	.0116	.6504	.5572	.0202
Residual	.9187			.6997			.6072			.6433		
Regression Constant	8.4889			8.6874			-2.6359			3.7723		
$100R^2$	15.58			51.04			63.13			58.62		

TABLE 4

TOTAL CAUSAL EFFECTS OF PREDICTOR VARIABLES FOR SCHOLASTIC PERFORMANCES IN LITERATURE AND SCIENCE

Independent Variables	Dependent Variables	Total Indirect Effects Through Intervening Variables	Direct Effect	Total Causal Effect
FATHOCC	VERBAL	-	.285	.285
	RDGCOMP	.182	.110	.292
	LIT	.233	.023	.256
	SCI	.208	.023	.231
FARED	VERBAL	-	.099	.099
	RDGCOMP	-.063	-.048	-.111
	LIT	.087	.026	.113
	SCI	.083	.038	.121
SIBEZ	VERBAL	-	-.168	-.168
	RDGCOMP	-.107	-.058	-.165
	LIT	-.133	.000	-.133
	SCI	-.128	-.028	-.156
SEX	VERBAL	-	.037	.037
	RDGCOMP	.024	.027	.051
	LIT	.038	.178	.216
	SCI	.037	-.170	-.133
VERBAL	RDGCOMP	-	.640	.640
	LIT	.406	.166	.572
	SCI	.351	.222	.573
RDGCOMP	LIT	-	.635	.635
	SCI	-	.548	.548

TABLE 5

RANK ORDER OF TOTAL CAUSAL EFFECTS OF PREDICTOR VARIABLES ON ENDOGENOUS VARIABLES[a]

Predictor	RANK ORDER							
	VERBAL[b]		RDGCOMP		LIT		SCI	
FATHOCC	1	(.285)	2	(.292)	3	(.256)	3	(.231)
PARED	3	(.099)	4	(.111)	6	(.113)	6	(.121)
SIBSZ	2	(-.168)	3	(-.165)	5	(-.133)	4	(-.156)
SEX	4	(.037)	5	(.051)	4	(.216)	5	(-.133)
VERBAL			1	(.640)	2	(.572)	1	(.573)
RDGCOMP					1	(.635)	2	(.548)

(a) The total causal effects from Table 4 are enclosed in parentheses

(b) Underlined TCE's are regarded as being of negligible substantive significance.

TABLE 6

DIFFERENCES IN COEFFICIENTS FOR THE VERBAL ABILITY AND READING COMPREHENSION EFFECTS ON LITERATURE AND SCIENCE FOR BOYS AND GIRLS SEPARATELY IN THE ENGLISH MODEL OF THE STRUCTURE OF SCHOLASTIC PERFORMANCE (UNSTANDARDIZED, STANDARDIZED COEFFICIENTS AND STANDARD ERRORS)

Relationship		Male			Female		
Regressor	Dependent Variable	Regression Coefficient	Path Coefficient	Standard Error	Regression Coefficient	Path Coefficient	Standard Error
VERBAL	LIT	.133	.159	.020	.148	.175	.021
VERBAL	SCI	.302	.199	.036	.350	.257	.034
RDGCOMP	LIT	.439	.647	.016	.439	.636	.017
RDGCOMP	SCI	.696	.562	.030	.614	.555	.028

FIGURE 1

CONCEPTUAL DIAGRAM OF THE BASIC MODEL OF SCHOLASTIC PERFORMANCE

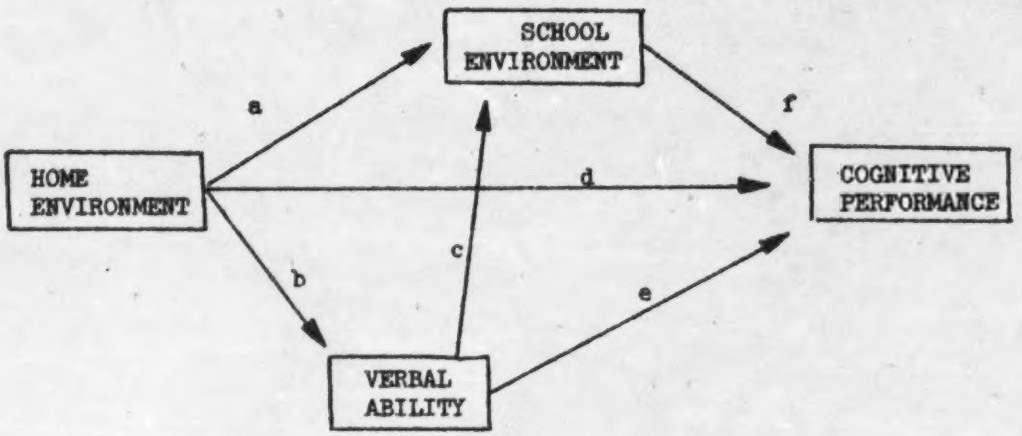
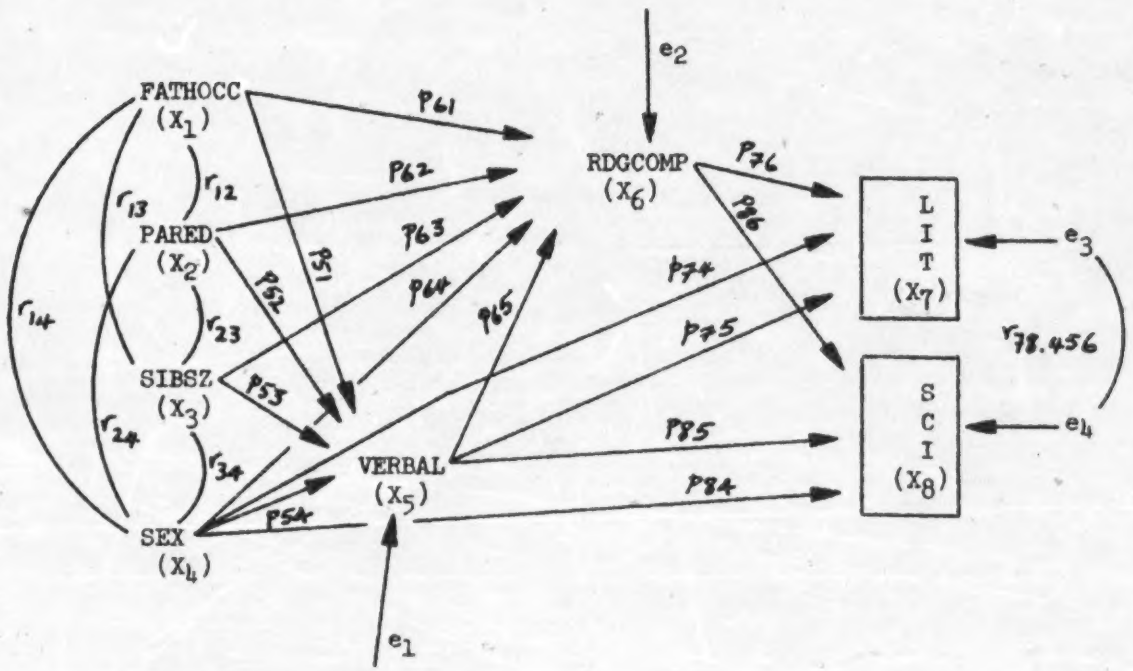


FIGURE 2

A CONCEPTUAL MODEL OF THE STRUCTURE OF SCHOLASTIC PERFORMANCE IN LITERATURE AND SCIENCE



Key to the mnemonics

X_1 FATHOCC = father's occupational status.

X_2 PARED = parental education (mother's education plus father's education).

X_3 SIBSZ = number of children in family.

X_4 SEX

X_5 VERBAL = verbal ability.

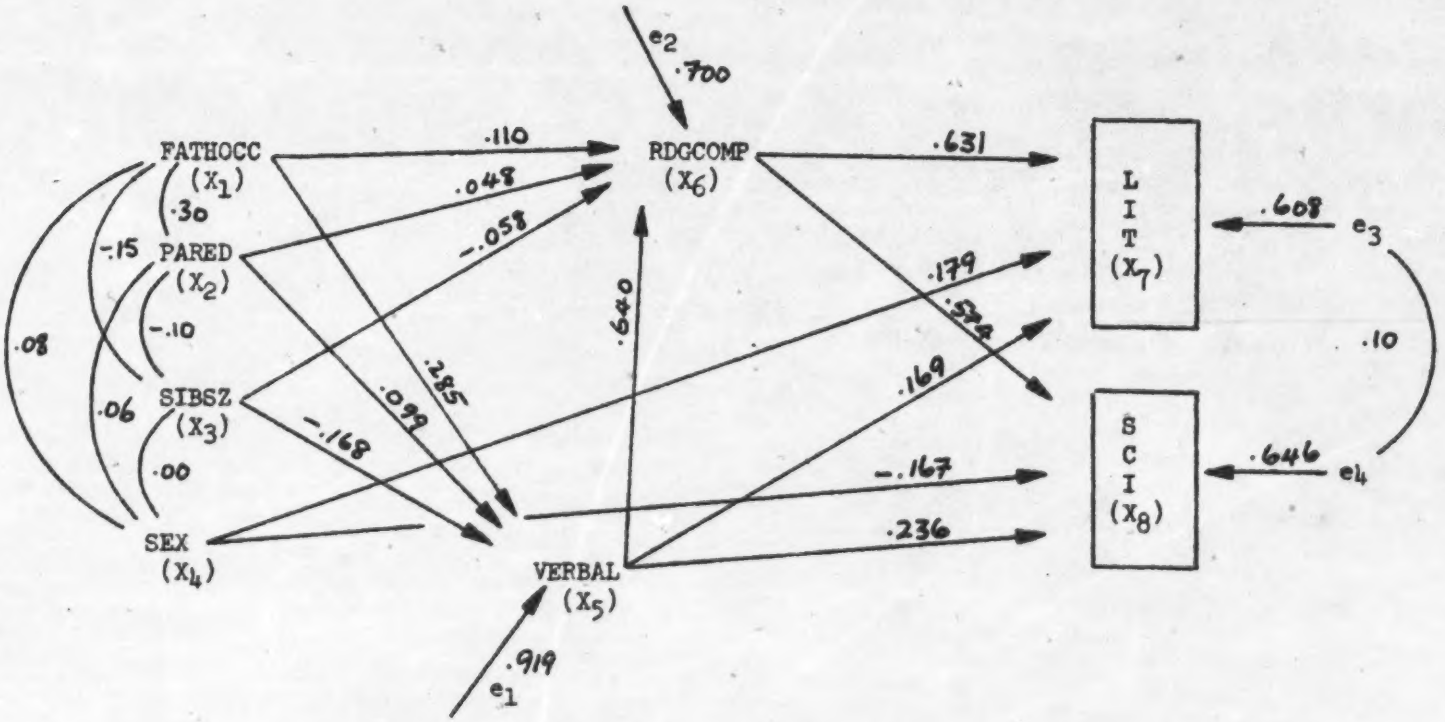
X_6 RDGCOMP = reading comprehension.

X_7 LIT = scholastic performance in Literature.

X_8 SCI = scholastic performance in science.

FIGURE 3

PATH MODEL OF THE STRUCTURE OF SCHOLASTIC PERFORMANCE IN LITERATURE AND SCIENCE[a]



[a] After the deletion of non-significant direct paths as a theory trimming device.

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